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DOES EXPORT COMPOSITION MATTER FOR ECONOMIC GROWTH IN THE UNITED ARAB EMIRATES?

Athanasia Stylianou Kalaitzi
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Abstract

This paper examines the export diversification process and the causality between disaggregated manufactured exports and economic growth in the United Arab Emirates (UAE). The study develops a model whereby domestic investments, gross domestic product, as well as disaggregated manufactured exports and imports of goods and services, are considered. The results show that chemicals and related products cause short-run economic growth, while a bi-directional causality exists between machinery and transport equipment exports and economic growth both in the short and long run. Therefore, the shift to machinery and transport equipment exports contributes to long-run, sustainable economic growth in the UAE.

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Introduction

The export-led growth (ELG) hypothesis suggests that export expansion is an effective strategy for accelerating economic growth. In particular, export expansion increases foreign exchange earnings, leading to increased investment, import expansion and technology transfer in the economy, which in turn improves national production.[1] While not all exports contribute equally to economic growth, primary exports are shown to be associated with lower growth rates.[2] For example, evidence from the Gulf Cooperation Council states (GCC), and from other countries, whose exports are mainly comprised of primary goods, shows that exports do not contribute to long-run economic growth. But what applies in the case of the UAE, which is the most diversified economy in the GCC region?[3] Previous evidence from the country reveals that merchandise exports cause economic growth in the short-run,[4] while primary exports are found to have a negligible impact.[5] Based on this, and on the fact that oil price volatility depresses incomes, this study focuses on disaggregated manufactured exports, in order to find the subcategories that enhance long-run economic growth in the UAE. The results will inform policymakers' decisions regarding the subcategories that should be promoted to sustain long-run growth in the country.

The data analysis shows that the UAE has experienced a high rate of economic growth and significant export diversification over the period between 1981–2019. In 2019, the value of manufactured exports increased by around 66 times, compared to the 1981 level (Figure 1), while their share in GDP grew from 1.6% in 1981 to 31.4% in 2019 (Figure 2).[6] At the same time, real GDP[7] in the UAE has been increasing at an average rate of 3.3% percent,

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[1] Bela Balassa, 'Exports and Economic Growth: Further Evidence', *Journal of Development Economics* 5/2 (1978), pp. 181–9; Raymond G. Riezman, Charles H. Whiteman and Peter M. Summers, 'The Engine of Growth of Its Handmaiden? A Time-Series Assessment of Export-Led Growth', *Empirical Economics* 21/1 (1997), pp. 77–110; Nasim S. Shirazi and Turkhan A. A. Manap, 'Exports and Economic Growth Nexus: The Case of Pakistan', *The Pakistan Development Review* 43/4 (2004), pp. 563–81.

[2] Jeffrey D. Sachs and Andrew M. Warner, 'Natural Resource Abundance and Economic Growth', *NBER Working Paper Series* no. 5398, December 1995.

[3] United Nations Conference on Trade and Development. Available at: https://unctadstat.unctad.org/EN/ (accessed 18 August 2022).

[4] Athanasia S. Kalaitzi and Trevor W. Chamberlain, 'Merchandise Exports and Economic Growth: Multivariate Time Series Analysis for the United Arab Emirates', *Journal of Applied Economics* 23/1 (2020), pp. 163–82.

[5] Athanasia S. Kalaitzi and Emmanuel Cleeve, 'Export-Led Growth in the UAE: Multivariate Causality Between Primary Exports, Manufactured Exports and Economic Growth', *Eurasian Business Review* 8/3 (2018), pp. 341–65.

[6] See: World Trade Organization Data Information on Trade and Trade Policy Measure. Available at: https://data.wto.org/ (accessed 18 August 2022); World Bank Open Data – World development Indicators. Available at: https://datatopics.worldbank.org/world-development-indicators/ (accessed 18 August 2022).

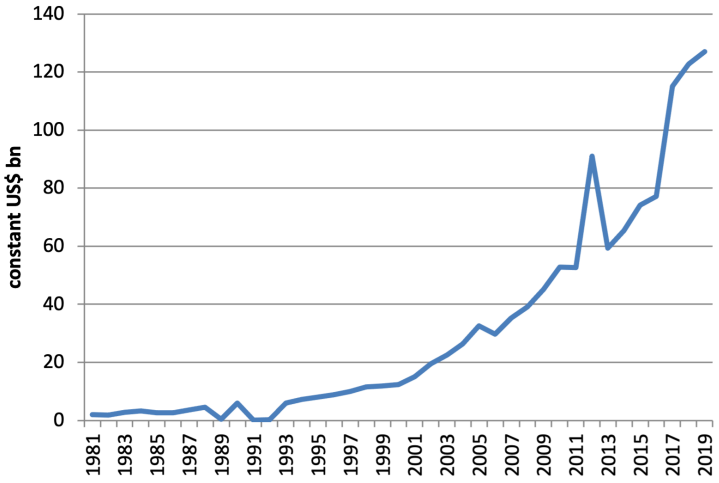
[7] However, as seen in Figure 3, the annual GDP growth in 1982 was estimated at around -6.7%, followed by a sharp decline to -15% in 1986, due to the collapse in oil price by over 50%. In 1990, the growth rate reached its peak at 18.3%, while it decreased to -5.2% in 2009.

while the average world growth rate has been estimated at around 3.1% (Figure 3).[8] But has export diversification contributed to economic growth in the UAE?

The specific objectives of this paper are to: (a) analyse the export diversification process that has been taking place in the country; (b) investigate the short-run and long-run causal effects of disaggregated manufactured exports on economic growth.

The remaining sections of this paper are organised as follows: Section 2 presents the UAE's export diversification level, while Section 3 reviews existing literature on the relationship between export composition and economic growth. Section 4 addresses the paper's research strategy and empirical results pertaining to the causal relationships between disaggregated exports and economic growth. Section 5 concludes with a summary and policy implications.

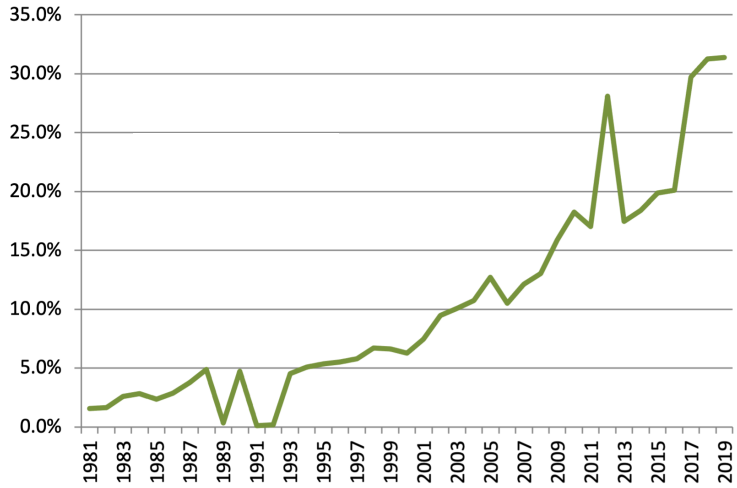
Figure 1: UAE Manufactured Exports, 1981–2019



Source: Authors' calculations using World Trade Organization (WTO)'s International Trade Statistics (2021)

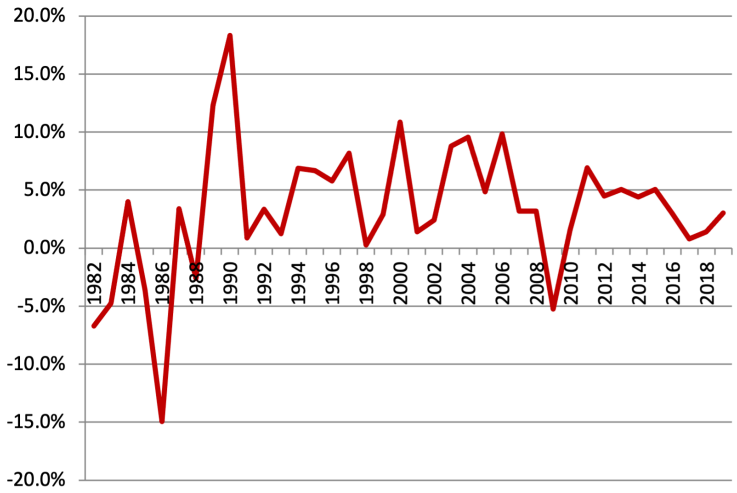
[8] World Bank Open Data.

Figure 2: Share of UAE Manufactured Exports as part of GDP, 1981–2019



Source: Authors' calculations using data from World Bank Word Development Indicators and the WTO (2021)

Figure 3: UAE GDP Annual Growth Rate, 1981–2019



Source: Authors' calculations using data from World Bank World Development Indicators (2021)

The UAE's Export Diversification

This research measures export diversification both horizontally and vertically. Horizontal export diversification occurs when there is an increase in the number of export sectors[9] or in the range of products.[10] On the other hand, vertical diversification occurs when there is a change in the share of each export sector,[11] or when there is a shift in the composition of exports from primary to manufactured products.[12]

The increase in the range of products (horizontal export diversification) and/or the shift in the composition of exports from primary to manufactured products (vertical diversification) decreases the variability of export earnings, which reduces uncertainty in the economy. The latter stimulates investment, resulting in the adoption of advanced technologies, which in turn increases national production and the rate of economic growth. At the same time, the decrease in export earning fluctuations allows the expansion of imports of services and capital goods, which are essential to achieving economic growth.

In this research, the selected measure for horizontal export diversification is the number of exported goods,[13] while the share of primary and manufactured exports is used as measures for vertical diversification. The analysis has shown that the number of exported goods (HS6-digit products) has increased from 158 in 1991 to 4360 in 2019. Furthermore, the share of primary exports in total exports of goods has decreased from 84.9% in 1981 to 29.8% in 2018, while the share of manufactured exports has gradually increased from 3.4% in 1981 to 51.8% in 2018 (Figure 4). The data therefore shows that there has been a process of export diversification in the UAE over the past three decades, but to what degree has it taken shape?

[9] Marianne Matthee and Wim Naudé, 'Export Diversity and Regional Growth: Empirical Evidence from South Africa', *WIDER Research Paper*s no. 2007/11 (2007) the United Nations University, World Institute for Development Economics Research, Helsinki.

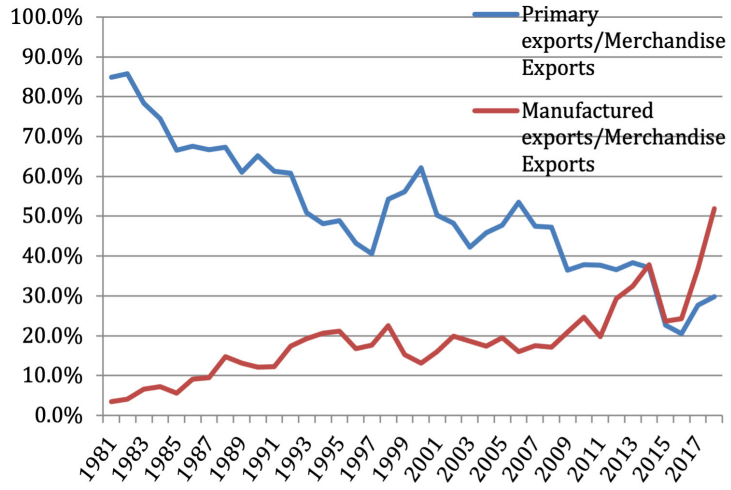
[10] Timothy G. Taylor, 'Export Diversification in Latin America and the Caribbean', *Farm and Business - The Journal of the Caribbean Agro-Economic Society* 7/1 (2007), pp. 157–75.

[11] Ibid.

[12] Matthee and Naudé, 'Export Diversity and Regional Growth.'

[13] Word Integrated Trade Solutions-WITS, HS6-digit products (2021). Available at: https://wits.worldbank.org (accessed 18 August 2022).

Figure 4: Vertical Diversification



Source: Authors' calculations using WTO data (2021)

To answer this question, two indices are used; the Herfindahl-Hirschman concentration (H) index and the Diversification (S) index. H index takes on values between 0 and 1, where values close to 1 indicate a low degree of export diversification. In the case of S index, which also takes on values between 0 and 1, a value closer to 1 indicates greater divergence from the world pattern.[14]

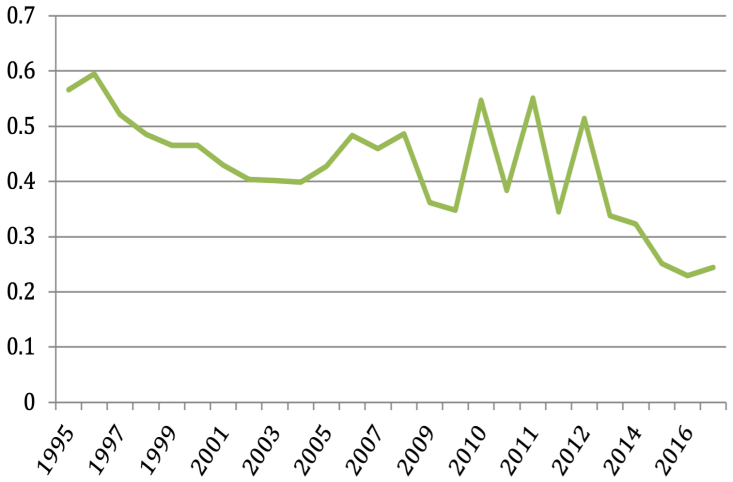
Resource-abundant countries tend to have these indices close to 1, but what is the UAE's export profile? An examination of the latter demonstrates that both indices have been declining since 1995. In particular, Figure 5 shows that in 1995 the concentration index had a value of 0.57, which has been on the decline, reaching 0.24 in 2017. Its downward trend was interrupted by some fluctuations during 2010–12, due to the impact of the financial crisis on export demand and global production.[15] In following years however, the index continued to decline, which indicates that the country does not rely on a limited number of export products. As for the diversification index, it has been decreasing from 0.71 in 1995 to 0.53 in 2017 (Figure 6), showing a lower divergence from the world pattern. This therefore demonstrates that the UAE has achieved a significant degree of export diversification and has moved away from primary exports.[16] But which categories of manufactured exports could further accelerate economic growth?

[14] A greater divergence from the world pattern leads to lower export diversification.

[15] Machiko Nissanke, 'The Global Financial Crisis and the Developing World: Transmission Channels and Fall-outs for Industrial Development,' *Research and Statistics Branch Working* Paper No. 06 (2009), United Nations Industrial Development Organization. Available at: https://bit.ly/3Ab3Ugy (accessed 19 August 2022).

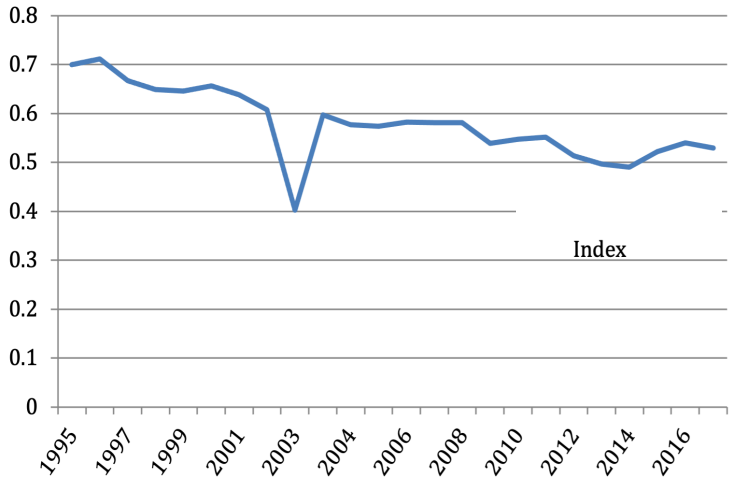
[16] Figures A1 and A2 in the appendix present the concentration and diversification indices in the GCC region.

Figure 5: Concentration Index (H) in the UAE, 1995–2019



Source: Author's calculations using data taken from the UNCOMTRADE database (2021), available at: https://comtrade.un.org/Data/ (accessed 19 August 2022)

Figure 6: Diversification Index (S) in the UAE, 1995–2019



Source: Authors' calculations using data taken from the UNCOMTRADE database (2021), available at: https://comtrade.un.org/Data/ (accessed 19 August 2022)

The Relationship Between Export Composition and Economic Growth

Several studies note the positive effect of exports on economic growth.[17] In particular, export expansion encourages resource reallocation, which increases investment, productivity and technological improvements.[18] At the same time, increased export revenues fuel import expansion, providing raw, intermediate and capital goods, which are essential for national production. Figure 7 depicts this link between exports and economic growth.

Figure 7: The Link Between Exports and Economic Growth

Source: Figure created by authors for the purpose of this study (2021)

[17] Balassa, 'Exports and Economic Growth'; Riezman, Whiteman and Summers, 'The Engine of Growth of Its Handmaiden?; Shirazi and Manap, 'Exports and Economic Growth Nexus'; Kalaitzi and Chamberlain, 'Merchandise Exports and Economic Growth.'

[18] World Bank, *The East Asian Miracle: Economic Growth and Public Policy* (New York: Oxford University Press, 1993). Available at: https://bit.ly/3QzFfct (accessed 19 August 2022).

However, a few studies indicate that exports can have a negative or negligible effect on economic growth, noting that this effect depends on the country's export product structure.[19] In particular, a high share of primary exports in total exports has been shown to be associated with lower growth, as this category of exports faces inelastic demand in the world market and is subject to price fluctuations.[20] Such conditions offset the positive effect of total exports.[21]

The above evidence has prompted studies focused on examining the causality between disaggregated exports and economic growth, with the majority of them concluding that a unidirectional or bi-directional causality exists between manufactured exports and economic growth,[22] while no causality exists between primary exports and economic growth.[23] However, it should be noted that not all manufactured exports contribute equally to the latter. A number of studies find that high-technology manufactured exports positively affect economic growth, while low-technology manufactured exports have a negligible effect.[24]

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[19] Sachs and Warner, 'Natural Resource Abundance and Economic Growth'; Thorvaldur Glyfason, Tryggvi Hebbertsson and Gylfi Zoega, 'A Mixed Blessing: Natural Resources and Economic Growth', *Macroeconomic Dynamics* 3/2 (1999), pp. 204–25; Turan Subasat, 'Does Export Promotion Increase Economic Growth? Some Cross- Section Evidence', *Development Policy Revie*w 20/3 (2002), pp. 333–49.

[20] Glyfason, Hebbertsson and Zoega, 'A Mixed Blessing: Natural Resources and Economic Growth'; Xavier Sala-i-Martin and Arvind Subramanian, 'Addressing the Natural Resource Curse: An Illustration from Nigeria', *NBER Working Paper* no. 9804 (June 2003); Boriss Siliverstovs and Dierk Herzer, 'Export-led Growth Hypothesis: Evidence for Chile', *Applied Economics Letters* 13/5 (2006), pp. 319–24; Setareh Sodeyfi and Salih Katircioglu, 'Interactions Between Business Conditions, Economic Growth and Crude Oil Prices', *Economic Research-Ekonomska Istraživanja* 29/1 (2016), pp. 980–90.

[21] This negative effect of exports on economic growth appears mainly in resource-abundant countries with low levels of human capital. See: Claudio Bravo-Ortega and Jose De Gregorio, 'The Relative Richness of the Poor? Natural Resources, Human Capital and Economic Growth', *The World Bank Policy Research Working Paper* Series no. 3484 (January 2005). There is evidence that petroleum exporting countries tend to suffer more; Davood Behbudi, Siab Mamipour and Azhdar Karami, 'Natural Resource Abundance, Human Capital and Economic Growth in Petroleum Exporting Countries', *Journal of Economic Development* 35/3 (2010), pp. 81–102.

[22] Neeven Torayeh, 'Manufactured Exports and Economic Growth in Egypt: Cointegration and Causality Analysis', *Applied Econometrics and International Developmen*t 11/1 (2011), pp. 111–35; Alper Aslan and Ebru Topcu, 'The Relationship Between Export and Growth: Panel Data Evidence from Turkish Sectors', *Economies* 6/2 (April 2018), pp. 1–15.

[23] Siliverstovs and Herzer, 'Export-led Growth Hypothesis'; Kalaitzi and Cleeve, 'Export-Led Growth in the UAE'; Athanasia S. Kalaitzi and Trevor W. Chamberlain, 'Fuel-Mining Exports and Growth in a Developing State: The Case of the UAE', *International Journal of Energy Economics and Policy* 10/4 (2020), pp. 300–8.

[24] Subrata Ghatak, Chris Milner and Utku Utkulu, 'Exports, Export Composition and Growth: Cointegration and Causality Evidence for Malaysia', *Applied Economics* 29/2 (1197), pp. 213–23; Jesus Cuaresma and Julia Wörz, 'On Export Composition and Growth', *Review of World Economics* 141/1 (April 2005), pp. 33–49; Martin Falk, 'High-Tech Exports and Economic Growth in Industrialized Countries', *Applied Economic Letters* 16/10 (June 2009), pp. 1025–8; Amelia Santos-Paulino, 'Export Productivity and Specialisation: A Disaggregated Analysis', *World Economy* 33/9 (2010), pp. 1095–1116; Emine Kilavuz and Betül Altay Topcu, 'Export and Economic Growth in the Case of the Manufacturing Industry: Panel Data Analysis of Developing Countries', *International Journal of Economics and Financial Issues* 2/2 (2012), pp. 201–15; Anwesha Aditya and Rajat Acharyya, 'Export Diversification, Composition, and Economic Growth: Evidence from Cross-Country Analysis', *The Journal of International Trade and Economic Devel-*

Within the Emirati context, previous research has provided evidence that primary exports, and especially fuel-mining exports, do not cause economic growth in the short or long term.[25] Based on this evidence, emphasis must be placed on disaggregated manufactured exports, to help design strategies that enhance long-run economic growth in the UAE. From 1981 to 2019, there is evidence of a structural shift from manufactured goods and miscellaneous manufactured articles to chemicals, machinery and transport equipment exports[26] (Figure 8). In particular, the share of manufactured goods and miscellaneous manufactured articles in manufactured exports decreased from 54.7% in 1981 to 40.5% in 2019. In contrast, the share of chemicals increased from 4.6% in 1981 to 10.1% in 2019, while machinery and transport equipment increased from 40.6% in 1981 to 49.3 in 2019.[27]

Additionally, the GDP share of the above export categories, which was estimated to be less than 1% in 1981, increased significantly in 2019 (Table 1). During the same period, GDP increased at an average growth rate of 3.3%, which was higher than that of high-income countries (2.6%). This study focuses on whether these export categories are the source for further economic growth in the UAE and, if so, identifies the categories that contribute to it in the long-run.

Table 1: Manufactured Exports' Share of GDP

Chemicals & related products		Machinery & Transport equipment		Manufactured goods (classified by material)		Miscellaneous manufactured articles	
1981	***2019***	***1981***	***2019***	***1981***	***2019***	***1981***	***2019***
0.1%	3.2%	0.6%	15.5%	0.4%	5.9%	0.5%	6.8%

Source: Author's calculations based on data taken from the World Bank-World Development Indicators and the UNCOMTRADE Database (2021)

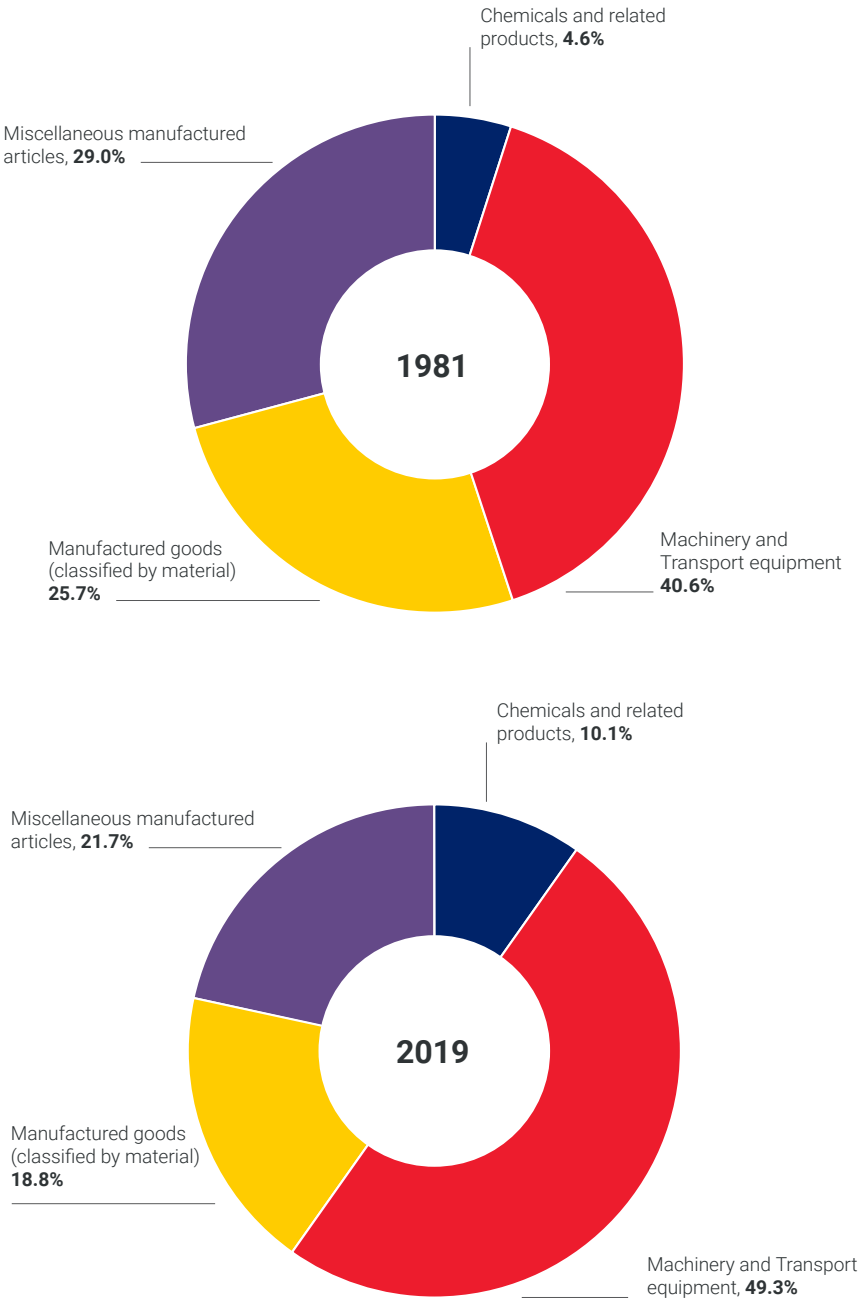
opment 22/7 (2013), pp. 959–92.

[25] Kalaitzi and Cleeve, 'Export-Led Growth in the UAE'; Kalaitzi and Chamberlain, 'Fuel-Mining Exports and Growth in a Developing State.'

[26] In the beginning of 1980s, the UAE government invested in manufacturing industries associated with oil, such as refineries, fertiliser plants and aluminium smelters, while the establishment of free zones, such as Jebel Ali Free Zone in 1985, attracted foreign direct investments in higher technology manufacturing. See: Shihab M. Ghanem, 'Industrialization in the UAE' in *United Arab Emirates: a New Perspective* (London: Trident Press, 2001).

[27] For more details about the type of products included in each sub-category of manufactured exports, see Figure A3 in the appendix.

Figure 8: Manufactured Exports Composition



Source: Author's calculations using data taken from UNCOMTRADE Database (2021)

Which Category of Manufactured Exports Contributes More to Economic Growth?

Theoretical Framework

To examine the relationship between disaggregated manufactured exports and economic growth, this study uses an augmented AK production function.[28] In particular, three sub-categories of manufactured exports, 1) chemical and related products, 2) manufactured goods and miscellaneous manufactured articles, and 3) machinery and transport equipment,[29] are modelled together with domestic investment and imports of goods and services, to examine their separate causal effect on the UAE's economic growth. Imported goods are included in the model,[30] as they can be considered as inputs for export-oriented production and their omission could lead to biased results. Furthermore, imports are considered a major channel for technology transfer and knowledge diffusion, which are essential to improving productivity and economic growth.[31]

In particular, this study assumes that aggregate production is a function of capital, imports of goods and services, and disaggregated manufactured exports – expressed in the following way:

$$Y_t = A_t K_t^{\alpha} \quad (1)$$

Where Y_t denotes the aggregate production of the UAE economy at time t, K_t represents the physical, human and R&D capital, while the constant α measures its impact on the production. At is the total factor productivity assumed to be a function of chemical and related products, $CHMX_t$, manufactured goods and miscellaneous manufactured articles, MNX_t, machinery and transport equipment, MTX_t, imports of goods and services, IMP_t, and other exogenous factors C_t:

$$A_t = f(CHMX_t, MNX_t, MTX_t, IMP_t, C_t) = CHMX_t^{\beta} MNX_t^{\gamma} MTX_t^{\delta} IMP_t^{\zeta} C_t \quad (2)$$

Combining equations (1) and (2) the production function becomes:

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[28] In the AK production function, capital includes physical capital as well as human capital and R&D capital. See: Paul M. Romer, 'Increasing Returns and Long-Run Growth', *The Journal of Political Economy* 94/5 (1986), pp. 1002–37; Robert E. Lucas Jr, 'On the Mechanics of Economic Development', *Journal of Monetary Economics* 22/1 (February 1998), pp. 3–42. The working age population was initially included in the estimates as a proxy for human capital, however, a bivariate cointegration test confirms that this variable is not cointegrated with the economic growth variable. At the same time, it does not take into account the quality of human capital.

[29] Due to the number of observations (39), the use of more disaggregated classification levels would lead to overparameterisation.

[30] Riezman, Whiteman and Summers, 'The Engine of Growth of Its Handmaiden?'

[31] David T. Coe and Elhanan Helpman, 'International R&D Spillovers', *European Economic Review* 39/1 (1995), pp. 859–87; Wolfgang Keller, 'Do Trade Patterns and Technology Flows Affect Productivity Growth?', *World Bank Economic Review* 14/1 (2000), pp. 17–47.

$$Y_t = C_t K_t^{\alpha} CHMX_t^{\beta} MNX_t^{\gamma} MTX_t^{\delta} IMP_t^{\zeta} \quad (3)$$

where α, β, γ, δ and ζ represent the elasticities of production with respect to the inputs of production: K_t, $CHMX_t$, MNX_t, MTX_t and IMP_t. After taking the natural logs of both sides of equation (3), the following is obtained:

$$LY_t = c + \alpha LK_t + \beta LCHMX_t + \gamma LMNX_t + \delta LMTX_t + \zeta LIMP_t + \varepsilon_t \quad (4)$$

c is the intercept, the coefficients α, β, γ, δ and ζ are constant elasticities, while ε_t is the error term.

Data

This study uses annual time series for the UAE over the period 1981–2019,[32] obtained from the World Bank, the International Monetary Fund and the UNCOMTRADE. Specifically, the gross domestic product (Y_t) is from the World Bank-World Development Indicators, while chemical and related products ($CHMX_t$), manufactured goods and miscellaneous manufactured articles (MNX_t) and machinery and transport equipment (MTX_t) are taken from UNCOMTRADE. Imports of goods and services (IMP_t) and gross fixed capital formation (K_t) are taken from the IMF International Financial Statistics and the World Bank-World Development Indicators. The macroeconomic variables are expressed in real terms, using the GDP deflator taken from the World Bank-World Development Indicators.

Econometric Methods

Unit Root Test

One of the major shortcomings of time-series variables is that they exhibit trends and this can lead to spurious results. For this reason, before testing the causality between disaggregated manufactured exports and economic growth, it is important to assess the stationary properties of the variables. This study applies the Augmented Dickey-Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test.

Short-run Granger Causality Test

The Vector Autoregressive Model (VAR), developed by Sims (1980),[33] is used to investigate whether disaggregated manufactured exports cause economic growth in the UAE, by including the optimal lag length of each variable in each equation. The VAR model comprises six variables: LY_t, LK_t, $LCHMX_t$, $LMNX_t$, $LMTX_t$, $LIMP_t$. In the VAR system of equations, all variables are treated as endogenous, while each variable appears as a dependent variable in one equation and as an independent variable in the other ones.

[32] Data for disaggregated manufactured exports is available from 1978; however, the sharp increase in oil prices by 131% in mid-1979, returning to the 1978 level in 1981, could affect the stability of the model. For this reason, the period 1981–2019 is used in this study.

[33] Christopher A. Sims, 'Macroeconomics and Reality', *Econometrica* 48/1 (1980), pp. 1–48.

This system allows us to find the direct causality, as well as the indirect causality between the variables under consideration. Before estimating the VAR model, the Johansen's cointegration test[34] is run to investigate the existence of a long run relationship between the variables. Provided that the variables are cointegrated (follow a common long-run path), the short-run causality can be tested by estimating the following restricted VAR (VECM) model:

$$\Delta LY_t = \sum_{j=1}^{p} \beta_{1j} \Delta LY_{t-j} + \sum_{j=1}^{p} \gamma_{1j} \Delta LK_{t-j} + \sum_{j=1}^{p} \delta_{1j} \Delta LCHMX_{t-j} + \sum_{j=1}^{p} \zeta_{1j} \Delta LMNX_{t-j} + \\ + \sum_{j=1}^{p} \theta_{1j} \Delta LMTX_{t-j} + \sum_{j=1}^{p} \mu_{1j} \Delta LIMP_{t-j} - \lambda_y \mathrm{ECT}_{t-1} + \varepsilon_{1t} \quad (5)$$

$$\Delta LK_t = \sum_{j=1}^{p} \beta_{2j} \Delta LY_{t-j} + \sum_{j=1}^{p} \gamma_{2j} \Delta LK_{t-j} + \sum_{j=1}^{p} \delta_{2j} \Delta LCHMX_{t-j} + \sum_{j=1}^{p} \zeta_{2j} \Delta LMNX_{t-j} + \\ + \sum_{j=1}^{p} \theta_{2j} \Delta LMTX_{t-j} + \sum_{j=1}^{p} \mu_{2j} \Delta LIMP_{t-j} - \lambda_k \mathrm{ECT}_{t-1} + \varepsilon_2 \quad (6)$$

$$\Delta LCHMX_t = \sum_{j=1}^{p} \beta_{3j} \Delta LY_{t-j} + \sum_{j=1}^{p} \gamma_{3j} \Delta LK_{t-j} + \sum_{j=1}^{p} \delta_{3j} \Delta LCHMX_{t-j} + \sum_{j=1}^{p} \zeta_{3j} \Delta LMNX_{t-j} \\ + \sum_{j=1}^{p} \theta_{3j} \Delta LMTX_{t-j} + \sum_{j=1}^{p} \mu_{3j} \Delta LIMP_{t-j} - \lambda_{chmx} \mathrm{ECT}_{t-1} + \varepsilon_{3t} \quad (7)$$

$$\Delta LMNX_t = \sum_{j=1}^{p} \beta_{4j} \Delta LY_{t-j} + \sum_{j=1}^{p} \gamma_{4j} \Delta LK_{t-j} + \sum_{j=1}^{p} \delta_{4j} \Delta LCHMX_{t-j} + \sum_{j=1}^{p} \zeta_{4j} \Delta LMNX_{t-j} \\ + \sum_{j=1}^{p} \theta_{4j} \Delta LMTX_{t-j} + \sum_{j=1}^{p} \mu_{4j} \Delta LIMP_{t-j} - \lambda_{mnx} \mathrm{ECT}_{t-1} + \varepsilon_{4t} \quad (8)$$

$$\Delta LMTX_t = \sum_{j=1}^{p} \beta_{5j} \Delta LY_{t-j} + \sum_{j=1}^{p} \gamma_{5j} \Delta LK_{t-j} + \sum_{j=1}^{p} \delta_{5j} \Delta LCHMX_{t-j} + \sum_{j=1}^{p} \zeta_{5j} \Delta LMNX_{t-j} \\ + \sum_{j=1}^{p} \theta_{5j} \Delta LMTX_{t-j} + \sum_{j=1}^{p} \mu_{5j} \Delta LIMP_{t-j} - \lambda_{mtx} \mathrm{ECT}_{t-1} + \varepsilon_{5t} \quad (9)$$

$$\Delta LIMP_t = \sum_{j=1}^{p} \beta_{6j} \Delta LY_{t-j} + \sum_{j=1}^{p} \gamma_{6j} \Delta LK_{t-j} + \sum_{j=1}^{p} \delta_{6j} \Delta LCHMX_{t-j} + \sum_{j=1}^{p} \zeta_{6j} \Delta LMNX_{t-j} \\ + \sum_{j=1}^{p} \theta_{6j} \Delta LMTX_{t-j} + \sum_{j=1}^{p} \mu_{6j} \Delta LIMP_{t-j} - \lambda_{imp} \mathrm{ECT}_{t-1} + \varepsilon_{6t} \quad (10)$$

LY_t represents economic growth, while LK_t, $LCHMX_t$, $LMNX_t$, $LMTX_t$ and $LIMP_t$ represent the independent variables of equation 4. Δ is the difference operator, β_{ij}, γ_{ij}, δ_{ij}, ζ_{ij}, θ_{ij}, μ_{ij} and λ_{ij} are the regression coefficients, while ECT_{t-1} is the error correction term derived from the cointegrating vector; p is the optimal lag length, selected by minimising the value of the Schwartz Information Criterion (SIC). Once the above equations have been estimated, diagnostic tests are conducted to determine whether the models are well specified.[35] In addition, this paper applies the cumulative sum of recursive residuals (CUSUM) test[36] in order to assess the parameter constancy of the ECM estimates.

[34] Soren Joahnsen, 'Statistical Analysis of Cointegrating Vectors', *Journal of Economic Dynamics and Control* 12/2-3 (1988), pp. 231-54.

[35] These tests include the Jarque-Bera normality test, the Portmanteau and Breusch-Godfrey LM tests for the existence of autocorrelation, the White heteroskedasticity test, the multivariate ARCH test and the AR roots stability test.

[36] Robert L. Brown, James Durbin and John M. Evans, 'Techniques for Testing the Constancy of Regression Relationships over Time', *Journal of the Royal Statistical Society* 37/2 (1975), pp. 149–92.

After investigating the constancy of the estimated parameters, this study conducts the multivariate Granger causality[37] in the VECM framework. The short-run causality between disaggregated manufactured exports and economic growth is examined by conducting a chi-square test and the following hypotheses are tested: $H_0: \sum_{j=1}^{p} \beta_{ij} = 0$, $H_0: \sum_{j=1}^{p} \gamma_{ij} = 0$, $H_0: \sum_{j=1}^{p} \delta_{ij} = 0$, $H_0: \sum_{j=1}^{p} \zeta_{ij} = 0$, $H_0: \sum_{j=1}^{p} \theta_{ij} = 0$, $H_0: \sum_{j=1}^{p} \mu_{ij} = 0$.

Long-run Granger Causality Test

It should be noted that in the case of multivariate error correction models, only the joint long-run causality from the explanatory variables to the dependent variable is indicated.[38] The individual causal effect of each variable on the dependent variable can only be identified in bivariate ECMs. Therefore, in the VECM (equations 5–10) it is not possible to confirm the validity of the ELG hypothesis in the long-run. For this reason, this study uses the Toda Yamamoto Granger causality test,[39] which reveals the individual causal effect of each variable on economic growth. In particular, the Toda and Yamamoto Granger causality test involves the following model:

$$LY_t = \alpha_{10} + \sum_{j=1}^{p+dmax} \beta_{1j} LY_{t-j} + \sum_{j=1}^{p+dmax} \gamma_{1j} LK_{t-j} + \sum_{j=1}^{p+dmax} \delta_{1j} LCHMX_{t-j} + \sum_{j=1}^{p+dmax} \zeta_{1j} LMNX_{t-j} + \sum_{j=1}^{p+dmax} \theta_{1j} LMTX_{t-j} + \sum_{j=1}^{p+dmax} \mu_{1j} LIMP_{t-j} + \varepsilon_{1t} \quad (11)$$

$$LK_t = \alpha_{20} + \sum_{j=1}^{p+dmax} \beta_{2j} LY_{t-j} + \sum_{j=1}^{p+dmax} \gamma_{2j} LK_{t-j} + \sum_{j=1}^{p+dmax} \delta_{2j} LCHMX_{t-j} + \sum_{j=1}^{p+dmax} \zeta_{2j} LMNX_{t-j} + \sum_{j=1}^{p+dmax} \theta_{2j} LMTX_{t-j} + \sum_{j=1}^{p+dmax} \mu_{2j} LIMP_{t-j} + \varepsilon_{1t} \quad (12)$$

$$LCHMX_t = \alpha_{30} + \sum_{j=1}^{p+dmax} \beta_{3j} LY_{t-j} + \sum_{j=1}^{p+dmax} \gamma_{3j} LK_{t-j} + \sum_{j=1}^{p+dmax} \delta_{3j} LCHMX_{t-j} + \sum_{j=1}^{p+dmax} \zeta_{3j} LMNX_{t-j} + \sum_{j=1}^{p+dmax} \theta_{3j} LMTX_{t-j} + \sum_{j=1}^{p+dmax} \mu_{3j} LIMP_{t-j} + \varepsilon_{1t} \quad (13)$$

$$LMNX_t = \alpha_{40} + \sum_{j=1}^{p+dmax} \beta_{4j} LY_{t-j} + \sum_{j=1}^{p+dmax} \gamma_{4j} LK_{t-j} + \sum_{j=1}^{p+dmax} \delta_{4j} LCHMX_{t-j} + \sum_{j=1}^{p+dmax} \zeta_{4j} LMNX_{t-j} + \sum_{j=1}^{p+dmax} \theta_{4j} LMTX_{t-j} + \sum_{j=1}^{p+dmax} \mu_{4j} LIMP_{t-j} + \varepsilon_{1t} \quad (14)$$

[37] Clive W. J. Granger, 'Investigating Causal Relations by Economic Models and Cross-Spectral Models', *Econometrica* 37/3 (1969), pp. 424–38; Clive W. J. Granger, 'Some Recent Development in a Concept of Causality', *Journal of Econometrics* 39/1–2 (1988), pp. 199–211.

[38] If the ECTt-1 in a system equation is found to be negative and significant, this means that all the variables at the right hand side of the equation jointly cause the variable at the left hand side, in the long-run.

[39] Hiro Y. Toda and Taku Yamamoto, 'Statistical Inferences in Vector Autoregressions with Possibly Integrated Processes', *Journal of Econometrics* 66/1–2 (1995), pp. 225–50.

$$LMTX_t = \alpha_{50} + \sum_{j=1}^{p+dmax} \beta_{5j} LY_{t-j} + \sum_{j=1}^{p+dmax} \gamma_{5j} LK_{t-j} + \sum_{j=1}^{p+dmax} \delta_{5j} LCHMX_{t-j} + \sum_{j=1}^{p+dmax} \zeta_{5j} LMNX_{t-j} + \sum_{j=1}^{p+dmax} \theta_{5j} LMTX_{t-j} + \sum_{j=1}^{p+dmax} \mu_{5j} LIMP_{t-j} + \varepsilon_{1t} \quad (15)$$

$$LIMP_t = \alpha_{60} + \sum_{j=1}^{p+dmax} \beta_{6j} LY_{t-j} + \sum_{j=1}^{p+dmax} \gamma_{6j} LK_{t-j} + \sum_{j=1}^{p+dmax} \delta_{6j} LCHMX_{t-j} + \sum_{j=1}^{p+dmax} \zeta_{6j} LMNX_{t-j} + \sum_{j=1}^{p+dmax} \theta_{6j} LMTX_{t-j} + \sum_{j=1}^{p+dmax} \mu_{6j} LIMP_{t-j} + \varepsilon_{1t} \quad (16)$$

where p is the optimal lag length, selected by minimising the value of the SIC, while $dmax$ is the maximum order of integration of the variables. The selected lag length (p) is augmented by the maximum order of integration ($dmax$) and the chi-square test is applied to the first pVAR coefficients. To investigate the long-run causality between disaggregated manufactured exports and economic growth, the following hypotheses are tested: H_0: $\sum_{j=1}^{p+dmax} \beta_{ij} = 0$, H_0: $\sum_{j=1}^{p+dmax} \gamma_{ij} = 0$, H_0: $\sum_{j=1}^{p+dmax} \delta_{ij} = 0$, H_0: $\sum_{j=1}^{p+dmax} \zeta_{ij} = 0$, H_0: $\sum_{j=1}^{p+dmax} \theta_{ij} = 0$, H_0: $\sum_{j=1}^{p+dmax} \mu_{ij} = 0$.

Empirical Results

Tables 2 and 3 present the ADF and KPSS test results. In particular, the ADF test at the log level indicates that the null hypothesis of unit root cannot be rejected for all the variables at 5% significance level. In contrast, after taking the first difference of the variables, the null hypothesis of unit root can be rejected at the conventional level of significance. The KPSS test results confirm the ADF results, as the null hypothesis of stationarity is rejected at 5% for all the variables at log level. The first-differenced variables are found to be stationary at the conventional level of significance.

Table 2: ADF and KPSS Test Results at Logarithmic Level

	ADF	KPSS
LY_t	-3.36(c) [0]	0.73(b)**{5}
LK_t	-2.58(a) [0]	0.69(b)**{5}
$LCHMX_t$	-1.63(b) [0]	0.74(b)**{5}
$LMNX_t$	-1.89(b) [0]	0.69(b)**{5}
$LMTX_t$	0.94(c) [1]	0.68(b)**{5}
$LIMP_t$	-3.22(a)*[1]	0.73(b) **{5}

*Notes: *, ** denote the rejection of the null hypothesis at 10% and 5% respectively. Numbers in [ ] corresponding to ADF statistics are the optimal lags, chosen based on the SIC. Bandwidth in { } (Newey-West automatic) uses the Bartlett kernel estimation method. For the ADF test, all the time series are tested for the unit root including intercept and trend (a), intercept only (b), and no constant or trend (c), while for the KPSS the series are tested using intercept and trend (a) and intercept only (b). The letters in parentheses indicate the selected model following Dolado et al. (1990).*[40]

Table 3: ADF and KPSS Test Results at First Difference

	ADF	KPSS
ΔLY_t	-3.81(c) *** [0]	0.24(b) {3}
ΔLK_t	-5.58(c) *** [0]	0.11(b) {1}
$\Delta LCHMX_t$	-3.07(b) ** [7]	0.05(b) {3}
$\Delta LMNX_t$	-6.47(c) *** [1]	0.02(b) {0}
$\Delta LMTX_t$	-6.83(c) *** [1]	0.06(b) {3}
$\Delta LIMP_t$	-3.66(b) *** [0]	0.10(b) {2}

*Notes: **, *** denote the rejection of the null hypothesis at 5% and 1% respectively. Numbers in [ ] corresponding to ADF statistics are the optimal lags, chosen based on the SIC. Bandwidth in { } (Newey-West automatic) uses the Bartlett kernel estimation method. For the ADF test, all the time series are tested for the unit root including intercept and trend (a), intercept only (b), and no constant or trend (c), while for the KPSS the series are tested using intercept and trend (a) and intercept only (b). The letters in parentheses indicate the selected model following Dolado et al. (1990).*

Since all variables are integrated of order one, I(1), the Johansen cointegration test is run to examine the existence of a long-run relationship between the variables (see the results in Table 4). The adjusted trace statistics indicate that the null hypothesis of one cointegrating vector is rejected at the 5% significance level and, therefore, the variables are cointegrated with two cointegrating vectors.

[40] Juan J. Dolado, Tim Jenkinson and Simon Sosvilla-Rivero, 'Cointegration and Unit Roots', *Journal of Economic Surveys* 4/3 (1990), pp. 33–49.

Table 4: Johansen's Cointegration Test Results

Hypothesized Number of Cointegrating Equations	Adjusted Trace Statistic
r=0	129.43**
r≤1	83.91**
r≤2	52.92

Note: Critical values are taken from MacKinnon-Haug-Michelis (1999). The model includes a restricted constant (following the Pantula Principle[41]). The lag length for the cointegration test is determined by minimizing the SIC. The diagnostic tests reveal that the residuals are multivariate normal and homoscedastic, while there is no evidence of serial correlation.

*** indicate rejection at 10%, 5% and 1% respectively*

Since the variables are integrated of order one and cointegrated, a VECM is specified and the Granger causality test is applied (see the results in Table 5 below).

Table 5: Short-run Granger Causality Test

	Source of Causality						
Dependent Variable	ΔLY_t	ΔLK_t	$\Delta LCHM_t$	$\Delta LMNX_t$	$\Delta LMTX_t$	$\Delta LIMP_t$	ALL
	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (5)	χ^2 (5)
ΔLY_t	-	4.79**	7.38***	0.62	5.64**	0.29	19.21***
ΔLK_t	0.02	-	0.22	0.76	1.68	1.42	3.42
$\Delta LCHMX_t$	0.98	3.65*	-	5.59**	47.55***	0.53	59.04***
$\Delta LMNX_t$	0.46	2.12	12.41***	-	41.37***	0.61	51.77***
$\Delta LMTX_t$	6.61**	3.54*	10.88***	3.63*	-	0.17	47.60***
$\Delta LIMP_t$	2.02	0.90	1.97	2.75*	0.15	-	6.31

*Note: *, ** and *** indicate significance at 10%, 5% and 1% respectively (df in parentheses). Diagnostic tests for the VECM model show that serial correlation is not present, while the residuals are multivariate normal and homoscedastic. In addition, the stability of the VECM is confirmed based on calculations of the inverse roots of the characteristic AR polynomial.*

The reported results in Table 5 reject the null hypothesis in both cases of testing non-causality from 1) chemical and related products and 2) machinery and transport equipment to economic growth in the short run at the 1% and 5% significance level respectively. In contrast, the null hypothesis of non-causality from manufactured goods and miscellaneous manufactured articles to economic growth cannot be rejected at any conventional significance level.

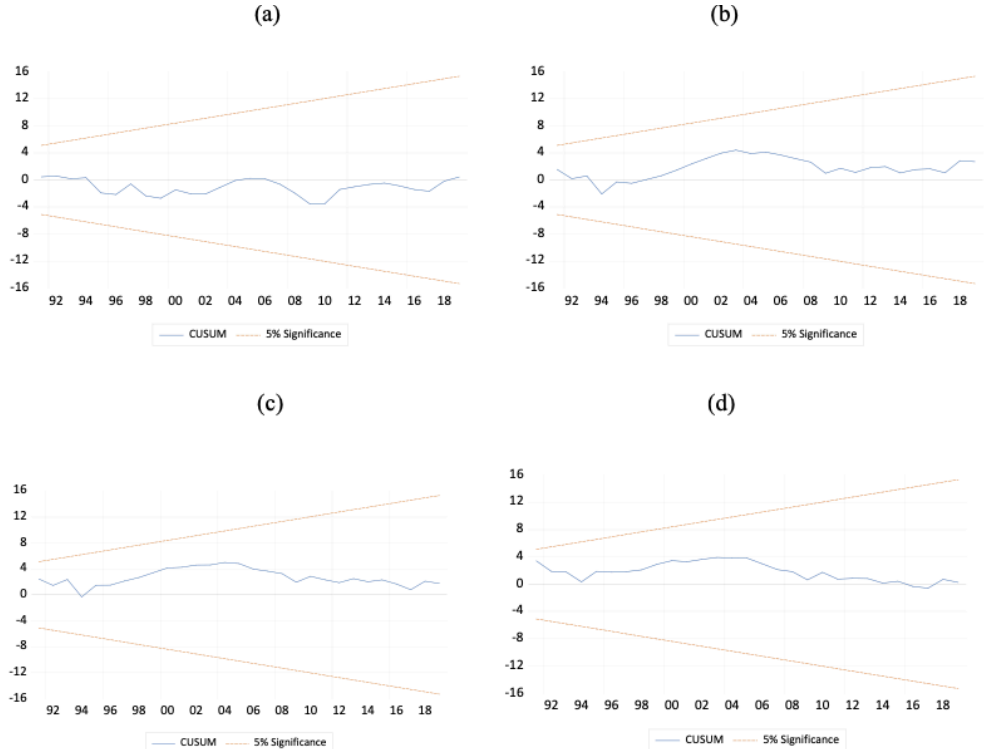
[41] Sastry G. Pantula, 'Testing for Unit Roots in Time Series Data', *Econometric Theory* 5/2 (1989), pp. 256–71.

Also, the results reject the null hypotheses of non-causality from domestic investment[42] to economic growth, chemical products, machinery and transport equipment at a conventional level of significance. At the same time, there is causality between all the sub-categories of manufactured exports. In addition, all the variables jointly cause economic growth and the growth in exports of manufactured, chemical, machinery and transport equipment goods.

The above results confirm that chemicals, machinery and transport equipment, improve productivity through domestic investment and technological advancement, while manufactured goods and miscellaneous manufactured articles do not cause economic growth. However, they do finance the expansion of chemicals and machinery and transport equipment, which indirectly contributes to it.

Since the aim of this paper is to find the direction of the causality between disaggregated manufactured exports and economic growth, the CUSUM test is used to assess the constancy of the parameters of the estimated equations[43] (5) and (7-9). As it can be seen from Figure 9, there is no movement outside the 5% critical lines of parameter stability (in red). The models for (a) LY_t, (b) $LCHMX_t$, (c) $LMNX_t$ and (d) $LMTX_t$ are stable even during the oil crises that occurred during the period 1981-2019.

Figure 9: Plots of CUSUM for the Estimated ECMs for (a) LY_t, (b) $LCHMX_t$, (c) $LMNX_t$ and (d) $LMTX_t$



[42] This includes physical capital, human and R&D capital.

[43] The diagnostic tests reveal that the residuals are multivariate normal and homoscedastic and there is no evidence of serial correlation. Diagnostic tests are available upon request.

With regards to long-run causality, the Toda and Yamamoto Granger causality test is applied and the results are presented in Table 6. The results reject the null hypothesis that chemical products do not cause economic growth, at the 10% significance level. However, there is no evidence to support the converse, as the results do not reject the null hypothesis of non-causality from economic growth to chemicals at any conventional significance level. The results also reject the null hypothesis of non-causality from machinery and transport equipment to economic growth at the 10% level, as well as the one of economic growth to machinery and transport equipment at 5%, indicating the existence of a bi-directional causality. Evidence also suggests that causality exists between chemical products and machinery and transport equipment, as the relevant null hypothesis is rejected at 5%. Therefore, the Toda-Yamamoto results support the validity of the ELG in the case of chemical products and machinery and transport equipment, while a bi-directional causality exists between machinery and transport equipment and economic growth in the long-run.

Table 6: Causality based on the Toda-Yamamoto procedure

	Source of Causality						
Dependent Variable	LY_t	LK_t	$LCHMX_t$	$LMNX_t$	$LMTX_t$	$LIMP_t$	*ALL*
	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (1)	χ^2 (5)
LY_t	-	0.25	3.02*	0.05	3.68*	0.00	6.61
LK_t	2.24	-	2.32	5.10**	1.36	0.42	8.56
$LCHMX_t$	2.32	0.00	-	0.25	4.59**	0.12	14.77**
$LMNX_t$	1.54	0.06	4.84**	-	4.41**	0.21	11.93**
$LMTX_t$	5.80**	0.10	3.98**	0.35	-	0.03	11.35**
$LIMP_t$	6.40**	3.57*	2.00	2.24	0.14	-	15.02**

, ** and * indicate significance at 10%, 5% and 1% respectively. The diagnostic tests for the select VAR(p) model prior to the application of the Toda-Yamamoto procedure show that serial correlation is not present, while the residuals are multivariate normal and homoscedastic.*

The above results show that not all manufactured exports equally contribute to economic growth in the long-run. As in the short-run, chemicals, and machinery and transport equipment lead to economic growth, while manufactured goods and miscellaneous manufactured articles do not. It should be noted that manufactured goods and miscellaneous manufactured articles, in contrast with the short-run, do not contribute to the expansion of chemicals, machinery, and transport equipment exports in the long-run.

To sum up, chemicals and machinery and transport equipment cause economic growth in the UAE in the long-run, while manufactured goods and miscellaneous manufactured articles have negligible effect.[44] Therefore, 'the failure of studies that use aggregate data to find support for the ELG hypothesis may be due to the effect of different components of exports cancelling each other out.'[45]

Conclusion

This study examined export diversification and the causality between disaggregated manufactured exports and economic growth in the UAE, over the period 1981–2019. The analysis has shown that the UAE no longer relies on a limited number of export products, which indicates a high degree of export diversification.

The cointegration results confirm the existence of long relationships between domestic investments, disaggregated manufactured exports and economic growth. The causality test results confirm that the export of chemicals and related products cause economic growth in the short-run. Also, a bi-directional causal relationship exists between machinery and transport equipment exports and economic growth. In addition, the evidence suggests that manufactured goods and miscellaneous manufactured articles can finance the expansion of chemicals, machinery, and transport equipment, but only in the short-run. In the long-run, machinery and transport equipment exports cause economic growth, and, in turn, the latter furthers expansion, which confirms the presence of circular causation.

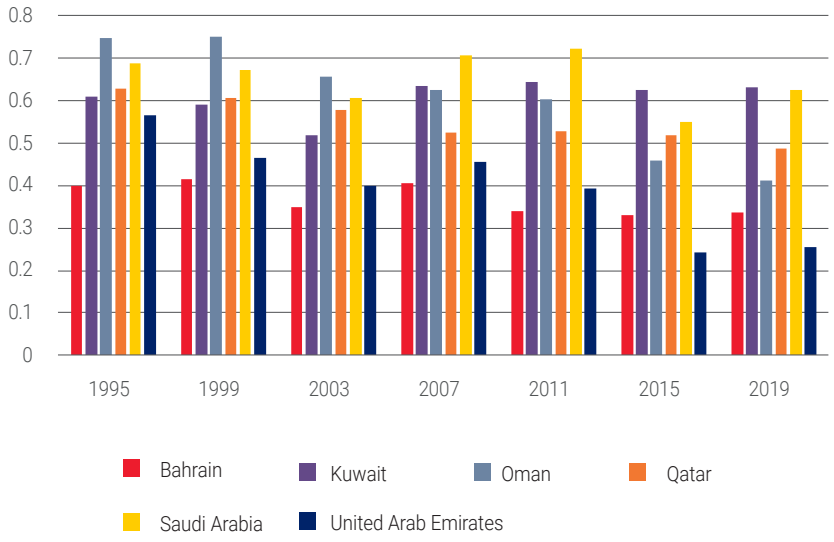
In general, the evidence suggests that machinery and transport equipment exports offer knowledge spillover effects and other positive externalities, achieving further economic growth in the UAE. Therefore, a shift from manufactured goods and articles to machinery and transport equipment would further contribute to long-run sustainable economic growth in the country. However, focus must be also placed on increasing domestic investment in physical capital, human capital and R&D, as well as expanding productivity-enhancing imports to foster long-run export diversification. Further research could benefit from analysing a disaggregated classification level of machinery and transport equipment exports, in order to find the sub-category that drives long-run economic growth.

[44] Ghatak, Milner, and Utkulu, 'Exports, Export Composition and Growth'; Cuaresma and Wörz, 'On Export Composition and Growth'; Falk, 'High-Tech Exports and Economic Growth in Industrialized Countries'; Santos-Paulino, 'Export Productivity and Specialisation'; Kilavuz and Topcu, 'Export and Economic Growth in the Case of the Manufacturing Industry'; Aditya and Acharyya, 'Export Diversification, Composition, and Economic Growth.'

[45] Subrata Ghatak and Stephen Price, 'Export Composition and Economic Growth: Cointegration and Causality Evidence for India', *Review of World Economics* 133/3 (1997), pp. 538–53.

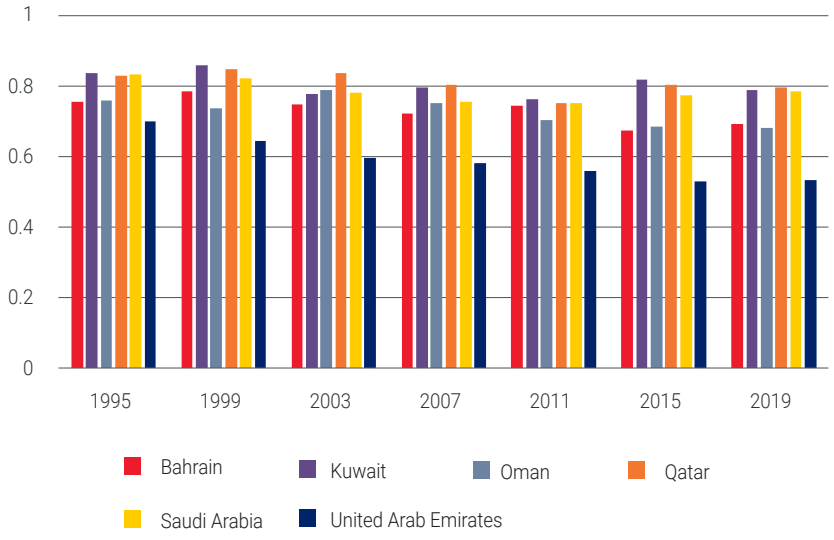
Appendix

Figure A1: Concentration Index in the GCC, 1995-2019



Source: Authors' calculations using data taken from the UNSTAD46

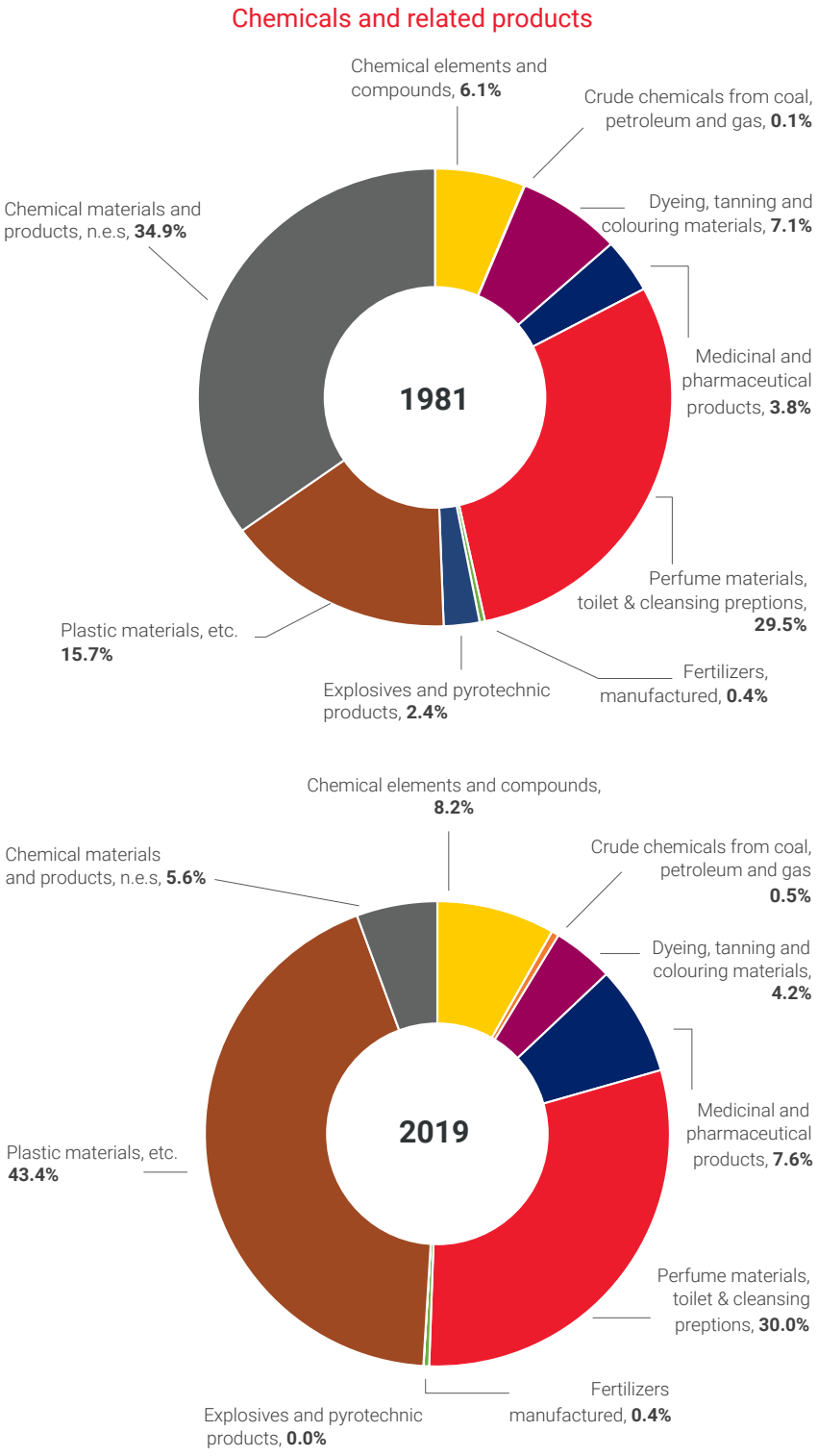
Figure A2: Diversification Index in the GCC, 1995-2019



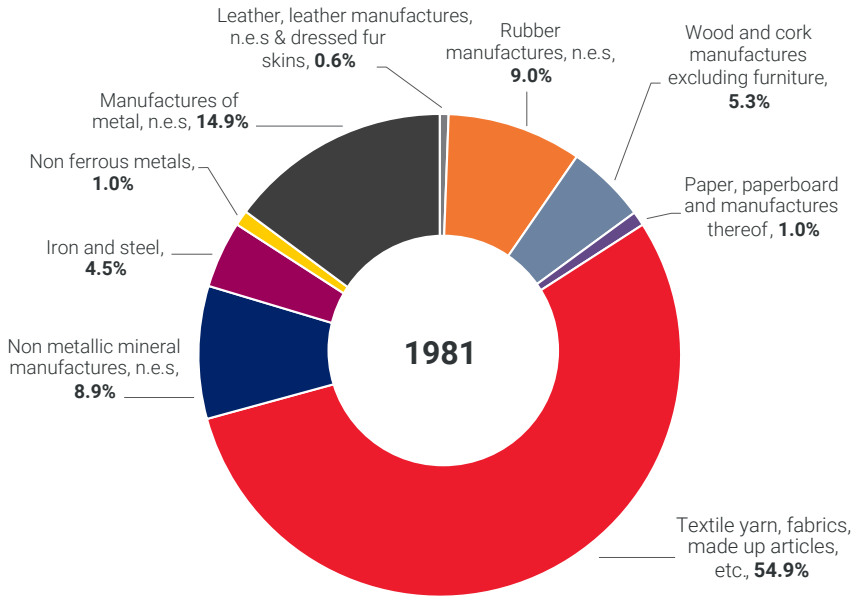
Authors' calculations using data taken from the UNSTAD

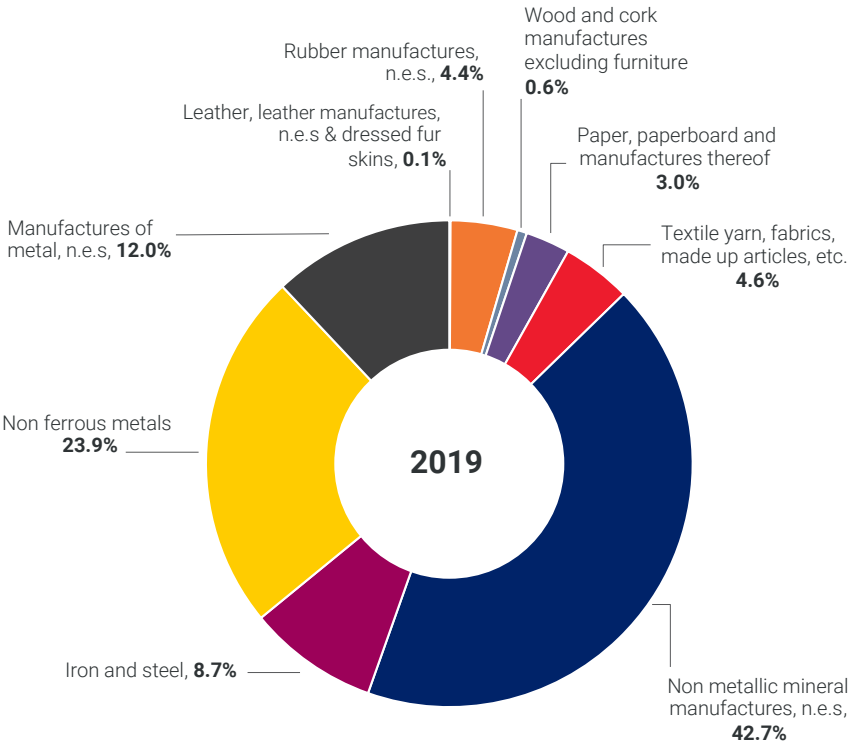
[46] Available at: https://unctadstat.unctad.org/EN/

Figure A3: Structure of sub-categories of manufactured exports

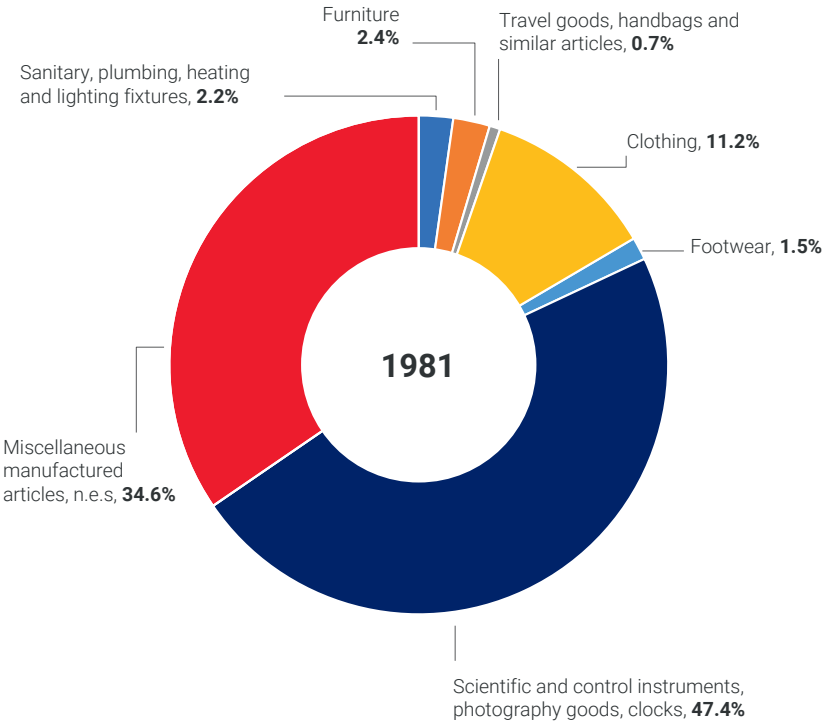


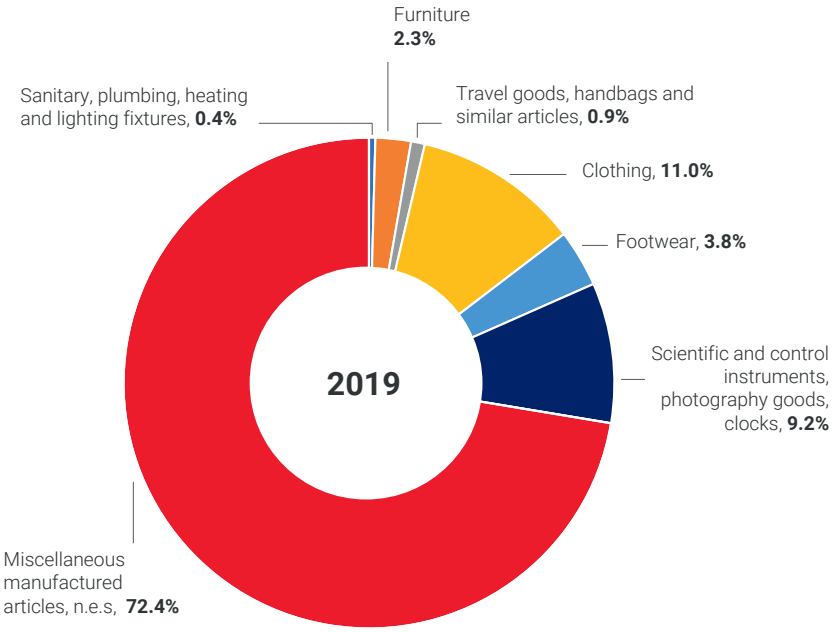
Manufactured goods (classified by material)

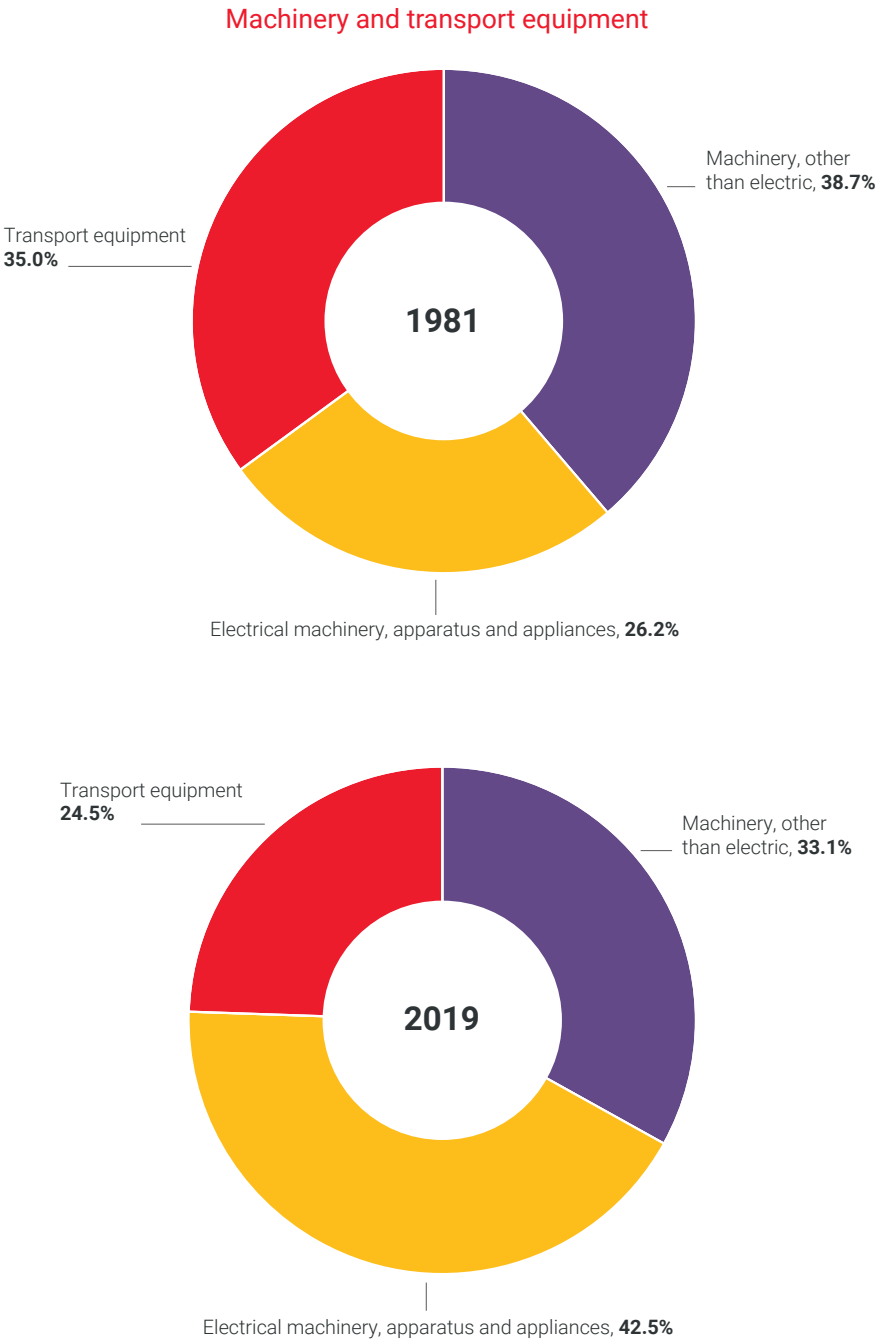




Miscellaneous manufactured articles






Machinery and transport equipment
Machinery, other than electric, 38.7%
Transport equipment 35.0%
1981
Electrical machinery, apparatus and appliances, 26.2%
Transport equipment 24.5%
Machinery, other than electric, 33.1%
2019
Electrical machinery, apparatus and appliances, 42.5%

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